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July 14, 2006

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Subject: Duke Power Company LLC
Oconee Nuclear Station
Docket Nos. 50-287
Licensee Event Report 287/2006-01, Revision 0
Problem Investigation Process No.: O-06-3002

Gentlemen:

Pursuant to 10 CFR 50.73 Sections (a)(1) and (d), attached is Licensee Event Report 287/2006-01, Revision 0, regarding a valid actuation of Keowee Hydro Station, the hydroelectric facility used in lieu of emergency diesel generators at the Oconee Nuclear Station.

This report is being submitted in accordance with 10 CFR 50.73 (a)(2)(iv)(A) and (B)(8).

This event is considered to be of no significance with respect to the health and safety of the public.

Very truly yours,

Bruce Hamilton

Bruce H. Hamilton, Vice President
Oconee Nuclear Site

Attachment

IE22

NRC FORM 366 U.S. NUCLEAR REGULATORY COMMISSION
(6-2004)

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 06/30/2007

Estimated burden per response to comply with this mandatory collection request: 50 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records and FOIA/Privacy Service Branch (T-5 F52), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

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4. TITLE

Actuation of Emergency Generator due to Spurious Transformer Lockout

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MO	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO	MO	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
									None	05000
05	15	2006	06	- 01	- 00	7	14	2006	FACILITY NAME: None	DOCKET NUMBER: 05000

9. OPERATING MODE

6

10. POWER LEVEL

0

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: *(Check all that apply)*

☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☐ 50.73(a)(2)(i)(C)	☐ 50.73(a)(2)(vii)
☐ 20.2201(d)	☐ 20.2203(a)(3)(ii)	☐ 50.73(a)(2)(ii)(A)	☐ 50.73(a)(2)(viii)(A)
☐ 20.2203(a)(1)	☐ 20.2203(a)(4)	☐ 50.73(a)(2)(ii)(B)	☐ 50.73(a)(2)(viii)(B)
☐ 20.2203(a)(2)(i)	☐ 50.36(c)(1)(i)(A)	☐ 50.73(a)(2)(iii)	☐ 50.73(a)(2)(ix)(A)
☐ 20.2203(a)(2)(ii)	☐ 50.36(c)(1)(ii)(A)	☒ 50.73(a)(2)(iv)(A)	☐ 50.73(a)(2)(x)
☐ 20.2203(a)(2)(iii)	☐ 50.36(c)(2)	☐ 50.73(a)(2)(v)(A)	☐ 73.71(a)(4)
☐ 20.2203(a)(2)(iv)	☐ 50.46(a)(3)(ii)	☐ 50.73(a)(2)(v)(B)	☐ 73.71(a)(5)
☐ 20.2203(a)(2)(v)	☐ 50.73(a)(2)(i)(A)	☐ 50.73(a)(2)(v)(C)	☐ OTHER
☐ 20.2203(a)(2)(vi)	☐ 50.73(a)(2)(i)(B)	☐ 50.73(a)(2)(v)(D)	☐ Specify in Abstract below or in NRC Form 366A

12. LICENSEE CONTACT FOR THIS LER

FACILITY NAME	TELEPHONE NUMBER (Include Area Code)
B.G. Davenport, Regulatory Compliance Manager	(864) 885-3044

13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX

14. SUPPLEMENTAL REPORT EXPECTED			15. EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR
☐ YES (If yes, complete EXPECTED SUBMISSION DATE)	☒	NO				

16. ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)

On May 15, 2006, Unit 3 was in day 17 of a refueling outage. The unit was in Mode 6, with fuel reload activities complete. At 1059 hours, during performance of a maintenance activity, a technician moving/jarring an open electrical cabinet door inadvertently caused an invalid actuation of a lockout relay for CT-3, the start-up auxiliary power transformer in service supplying power to the unit. A loss of power occurred, resulting in a valid actuation of Keowee Hydro Station, the Oconee emergency on-site power source.

Power was restored automatically after approximately 40 seconds and decay heat removal was restored after 14 minutes. The root causes were determined to be less than adequate establishment of work practices as well as a design deficiency for having an impact sensitive relay mounted on an electrical cabinet door.

This event is considered to have no significance with respect to the health and safety of the public.

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17. NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)*

EVALUATION:

BACKGROUND

This event is reportable per 10CFR 50.73(a)(2)(iv)(A) and (B)(8) as a valid actuation of one of the systems listed in the rule, specifically the Keowee Hydro Station (KHS) [EIIS:EK] used at Oconee Nuclear Station (ONS) in lieu of emergency diesel generators.

During start-ups, shutdowns, and outage periods where the Auxiliary Transformer (3T on Unit 3) [EIIS:XFMR] is not available, power is usually supplied from the Switchyard through the Start-up Transformer (CT-3 on Unit 3).

Emergency power can be provided to any or all of the three ONS units from KHS. There are two emergency power paths:

1) the over head path, which includes the Start-up Transformer (CT-1, CT-2, or CT-3) on each ONS unit; and

2) the underground path, through the Stand-by Bus Transformer (CT-4).

In addition there is a path from either Central Switchyard or Lee Steam Station via transformer CT-5.

Transformers 3T or CT-3 supply power at 6900 Volts (V) for operation of Reactor Coolant Pumps (RCPs) [EIIS:P] and at 4160 V for other auxiliary power loads. The RCPs are the only 6900 V loads at ONS and their control circuits contain logic interlock contacts from the 6900 V protective relays to prohibit the closure of the RCP switchgear while a transformer lockout signal exists. The RCP control circuits also have a number of additional logic interlocks, including oil level indications, which must be satisfied in order to start an RCP. The RCP motor oil level indicator lights and the X, Y, and Z phase CT-3 6900 V differential relays are located on the door of the RCP Interlock Indicator Panel (3TCPA).

On May 15, 2006, Unit 3 was in day 17 of a refueling outage. Prior to this event, Unit 3 was in Mode 6 with the core reloaded

following refueling. The Fuel Transfer Canal was full and connected to the Spent Fuel Pool (SFP) via the fuel transfer tubes. Decay Heat Removal (DHR) was being supplied by Low Pressure Injection (LPI) [EIIS:BP] pump 3C. The Reactor Building Equipment Hatch was open. Transformer 3T was out of service for maintenance. Transformer CT-3 was in service, energized from the Duke Power Company LLC (Duke) grid via the 230 KV Switchyard.

EVENT DESCRIPTION

On May 15, 2006, four Instrument and Electrical Maintenance Technicians performed an Instrument Procedure which checked the function of the RCP oil level interlocks. In part, this required observation of the status of indicating lights on the 3TCPA panel in the Turbine Building. One of the technicians elected to open the panel door, although not specifically required to do so by the procedure. At the end of the test, this technician observed that one of the light bulbs was "dim" and attempted to replace it. However, he had difficulty both in removing the old bulb from its socket and in reclosing the panel door. It is unknown how much the door was shaken while attempting to remove the old bulb or how much force was applied while attempting to engage the latch on the door. The event investigation concluded that sufficient impact force was applied to cause an inadvertent relay actuation.

At 1059 hours, CT-3 received a lockout signal. Following the event, the lockout was determined to be due to actuation of the 87L Z phase differential relay (located on the 3TCPA panel door) which caused the 87BU3/CT3 lockout relay to actuate.

The lockout resulted in a loss of power to both Unit 3 Main Feeder Busses (MFB) [EIIS:EB], which in turn initiated a unit load shed (which strips non-essential loads), and a KHS emergency start. Since the overhead path was not available due to the lockout on CT-3, power was automatically restored via the underground power path via CT-4. This evolution to restore power took approximately 40 seconds, which is the expected time based on system time delays and the response time for a KHS emergency start.

Operations entered several Abnormal Procedures (AP), specifically AP/3/A/1700/026 Loss of Decay Heat Removal (DHR), AP/3/A/1700/011 Recovery from Loss of Power, and AP/3/A/1700/035 Loss of SFP

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Cooling [EIIS:DA]. Operations initiated Reactor Building Evacuation and Containment Closure per the Loss of DHR AP.

DHR was restored at 1113 hours (i.e. 14 minutes after loss of power) by restarting LPI pump 3C. Reactor core temperature, as measured by the LPI cooler outlet temperature thermocouples, increased from 81 to 89 degrees.

Reactor Building Evacuation was completed at 1136 hours, 37 minutes into the event (not counting personnel involved in Equipment Hatch Closure activities inside containment).

At 1140, Equipment Hatch closure was complete, 41 minutes into the event.

At 1152, SFP cooling was reestablished, 53 minutes into the event. SFP temperature remained stable at 90 to 91 degrees.

At 1154, Containment Closure was completed, 55 minutes into the event.

At 1348, the event was reported as an eight hour non-emergency notification (event 42576).

At 2105, the power source was aligned to CT-5 (from Central Switchyard) and the KHS unit feeding the underground path was secured.

On May 16, 2006, at 1549 hours, Operations realigned power to the Start-up Source via CT-3, after troubleshooting and investigation confirmed that no faults existed and that the signal to actuate the CT-3 lockout relay was invalid.

Duke initiated an investigation to determine the physical cause of the event and the associated programmatic and human performance issues.

CAUSAL FACTORS

The Duke investigation found no problems with the equipment monitored and protected by the protective relays which actuated during this event. However, as stated above, the CT-3 6900 V

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differential relays are located on the door of Panel 3TCPA. These relays are sensitive to physical impact and can be actuated by mechanical impact/jarring. With the door open, the investigation team was able to recreate the lockout signal by closing the panel door with "light to medium" force. With the door closed, the investigation team was able to recreate the lockout signal by hitting the door with "medium to heavy" force.

Two root causes were identified for this event:

1. Management failed to establish and implement work practices and standards regarding entry into electrical enclosures/panels. Opening the 3TCPA cabinet door is considered an entry.

2. A design deficiency exists with the 3TCPA cabinet configuration:

a) Power system protective relays are mounted on the electrical cabinet door, which allows them to be susceptible to impact during routine maintenance activities.

b) Power system protective relays share the 3TCPA cabinet with other devices associated with unrelated systems.

CORRECTIVE ACTIONS

Immediate:

1. Power was restored to the MFBs automatically in approximately 40 seconds.

2. Operations entered appropriate APs and initiated Containment Evacuation and Closure.

3. Operations restored the DHR and SFP Cooling systems promptly upon restoration of power.

Subsequent:

1. Operations aligned Unit 3 power to CT-5 from Central Switchyard and shutdown KHS. Subsequently, Operations restored Unit 3 alignment to CT-3 from the ONS Switchyard.

Planned:

1. ONS will establish an engineering basis/guidance document for entry or opening of protective relay electrical enclosures/ panels. This document will address the impact of entry into protective relay electrical enclosures/panels. From this document, ONS will develop workplace guidance/directives to control entry into cabinets and to define and limit the scope of work activities allowed with access doors open on electrical panels/cabinets.

2. Modify the equipment in the 3TPCA cabinet to:
   a) address the issue of impact sensitive relays being mounted on the door; and
   b) separate the protective relaying from other non-related equipment.

None of the corrective actions listed above are considered NRC Commitment items. There are no other NRC Commitment items contained in this LER.

SAFETY ANALYSIS

This event did not include a Safety System Functional Failure.

The initiating event (actuation of the CT-3 lockout relay) was a spurious actuation due to mechanical impact of the relay while a technician was manipulating the panel door. Engineering noted that this type of mechanical impact is different from the vibrations produced during seismic events, thus the event does not indicate an inadequate seismic design.

The spurious lockout actuation resulted in an actual loss of AC power to the Unit 3 Main Feeder Busses. Therefore the resulting MFB Monitor Panel actuation and Emergency Start of KHS were valid actuations. All equipment at KHS, in the underground emergency power path, and in the Emergency Power Switching Logic responded as designed and power was restored in approximately 40 seconds.

Until the power was restored, all components connected to the MFB experienced an undervoltage condition (i.e. zero volts). 4160 V switchgear for non-essential components contain undervoltage

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protective relays which trip the switchgear breakers. In addition, the MFB Monitor Panel actuation includes a "load shed" signal which provides a safety related trip signal to these non-essential switchgear. Therefore any components considered non-essential must be restored manually. For example, LPI pump 3C tripped and Operators restored it (and DHR) approximately 14 minutes into the event, per the appropriate step in the loss of DHR procedure. Similarly the SFP Cooling Pumps required manual restart.

As a result of the 14 minute loss of DHR, the reactor core temperature heated up from 81F to 89F as measured by the LPI cooler outlet temperature thermocouples. During the outage the ONS Shutdown Risk directive requires generation of a daily "time to core boiling" based on expected heat load using the number of days after shutdown. For this event, the procedural time to core boil was 58 minutes. However, these calculations credit only the volume of water in the reactor vessel and do not credit the volume of water in the Fuel Transfer Canal, which was full. They also assume a starting temperature of 140F. Therefore they are extremely conservative. A calculation based on the time to heat the entire inventory of the Fuel Transfer Canal to 212F indicates that time to core boil was greater than 24 hours.

A Probabilistic Risk Assessment evaluation was performed which concluded that the impact of this event on the Core Damage and Large Early Release risks were insignificant.

Therefore, there was no actual impact on the health and safety of the public due to this event.

ADDITIONAL INFORMATION

The investigation reviewed prior events at ONS. There have been similar relay actuation events at ONS. None met the criteria to be considered recurring. The most recent prior event occurred in September 1999, when lockout relays for CT-1, the Unit 1 Start-up Transformer, actuated. An investigation into that event found that personnel working near 1TCPA, the equivalent cabinet on Unit 1, bumped the door, resulting in the relay actuation. In that event Unit 1 was at power so CT-1 was not supplying any loads and the event was not reportable.

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There were no releases of radioactive materials, radiation exposures or personnel injuries associated with this event.

This event is not considered reportable under the Equipment Performance and Information Exchange (EPIX) program.